

CLAIMS

1 1. A transcutaneous energy transfer device having an external primary coil to
2 which energy to be transferred is applied, and an implanted secondary coil inductively
3 coupled to said primary coil and connected to apply energy to a subcutaneous utilization
4 device, characterized by the inclusion of a magnetic shield covering said primary winding.

1 2. A device as claimed in claim 1 wherein said shield is larger than said primary
2 coil.

1 3. A device as claimed in claim 2 wherein said primary coil has a selected shape
2 and size, and wherein said shield is of substantially the same shape as said primary coil, but of
3 greater size.

1 4. A device as claimed in claim 3 wherein said primary coil has dimensions x_i in
2 direction i , wherein the shield has a thickness t and wherein the dimensions of the shield in
3 direction i is $X_i \geq x_i + 2t$.

1 5. A device as claimed in claim 3 wherein said primary coil has a generally
2 circular shape with a diameter d , and wherein said shield has a generally circular shape with a
3 diameter D , where $D > d$.

1 6. A device as claimed in claim 5 wherein said shield has a thickness t , and
2 wherein $D \geq d + 2t$.

1 7. A device as claimed in claim 5 wherein the shield is formed of a material
2 having a magnetic permeability relative to free space (μ) and has a thickness (t), where $t \gg D/\mu$.

1 8. A device as claimed in claim 1 wherein the shield is formed of a material
2 having a magnetic permeability relative to free space (μ), has a major dimension X , and has a
3 thickness (t) where $t \gg X/\mu$.

1 9. A device as claimed in claim 1 wherein said shield has a plurality of ventilation
2 perforations formed therein.

1 10. A device as claimed in claim 9 wherein said perforations are formed parallel to
2 the magnetic field direction.

1 11. A device as claimed in claim 10 wherein said primary coil is substantially
2 circular, and wherein said perforations are a plurality of radial slots.

1 12. A device as claimed in claim 9 wherein said perforations cover approximately
2 25% to 75% of the area of the shield.

1 13. A device as claimed in claim 12 wherein said perforations cover approximately
2 50% of the area of the shield.

1 14. A device as claimed in claim 12 wherein the perforations result in a reduction
2 in μ_s for the shield which is roughly proportional to the percentage of perforation area, and
3 wherein the shield thickness is increased so as to maintain the relationship $t \gg D/\mu_s$.

1 15. A device as claimed in claim 12 wherein all dimensions for the perforations are
2 less than the dimensions of the smallest coil in the device.

1 16. A device as claimed in claim 1 wherein said shield is flexible so as to be able
2 to conform to the contours of a patient's body.

1 17. A device as claimed in claim 16 wherein said shield is formed of a low loss
2 magnetic material in a flexible polymer matrix.

1 18. A device as claimed in claim 17 wherein said shield is formed of a ferrite
2 powder in a silicone rubber.

1 19. A device as claimed in claim 16 wherein said shield is formed of a plurality of
2 segments of a very high permeability material connected by a porous, flexible material.

1 20. A device as claimed in claim 19 wherein the spacings between adjacent
2 segments in a direction substantially parallel to the magnetic field direction of the primary coil
3 is less than the dimensions of the smallest coil in the device, and the spacing between adjacent
4 segments in a direction substantially perpendicular to the magnetic field direction is much less
5 than the spacing in said parallel direction.

1 21. A device as claimed in claim 19 wherein said segments cover approximately
2 25% to 75% of said shield area.

1 22. A device as claimed in claim 1 wherein said primary coil generates a magnetic
2 field which is directed both toward and away from said secondary coil and wherein said shield
3 is dimensioned and is formed of a material which reflects most of the magnetic field directed
4 thereto toward said secondary coil.

1 23. A device as claimed in claim 19 wherein said segments comprises:
2 a plurality of segments arranged in one or more concentric rings, each said
3 concentric ring including segments of substantially the same size.

1 24. A device as claimed in claim 23 wherein said plurality of segments are
2 constructed and arranged so as to form a gap between radially opposing segments in said ring,
and wherein said segments further comprises a center disk shaped to fit within said gap.

1 25. A device as claimed in claim 1, wherein said shield and said primary coil are
2 mounted together to form a primary coil assembly, and wherein a substantially impervious
3 coating is applied to said assembly.

1 26. A device as claimed in claim 25, wherein said primary coil assembly is vinyl
2 dip coated.

1 27. A device a claimed in claim 1, wherein said primary coil is operationally
2 decoupled from a drive circuit prior to physical disconnection of electrical contacts through
3 which current is transferred from the drive circuitry to said primary coil, and wherein physical
4 connection of electrical contacts through which current is transferred from the drive circuitry
5 to said primary coil occurs prior to operationally coupled the primary winding to the drive
6 circuit.

1 28. A device a claimed in claim 27, wherein said primary coil is electrically
2 coupled to the drive circuit via an electrical connector, wherein said electrical connector
3 includes power transfer contacts and anti-arcing contacts, wherein said anti-arcing contacts
4 electrically mate after and break before said power transfer contacts, said anti-arcing contacts
5 electrically connected to control circuitry operationally interposed between the drive circuit
6 from the primary winding.

1 29. A device a claimed in claim 28, wherein said control circuitry is located in said
2 drive circuitry.

1 30. A device a claimed in claim 28, wherein said control circuitry is located in said
2 connector.